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Searching for dark matter with a 1000 km baseline interferometer

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Axion-like particles (ALPs) arise from well-motivated extensions to the Standard Model and could account for dark matter. In the Milky Way, ALP dark matter constitutes a field oscillating at an as yet unknown frequency. We directly search for such particles through the nucleon interaction. We interfere the signals of two atomic K-3He comagnetometers situated in Mainz, Germany, and in Krakow, Poland. We take into account the ALP dark matter temporal and spatial coherence properties, assuming the Standard Halo Model, to improve the sensitivity and exclude spurious candidates. The search extends for seven orders of magnitude in ALP mass. In this range, no significant evidence of an ALP signal is found. We thus place a new upper limit in the ALP-neutron and proton coupling improving previous laboratory constraints.

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